Survival Experience of Aged Hip Fracture Patients

JAY MAGAZINER, PHD, MSHYG, ELEANOR M. SIMONSICK, PHD, T. MICHAEL KASHNER, PHD, J. RICHARD HEBEL, PHD, AND JOHN E. KENZORA, MD

Abstract: Hip fracture has long been considered a major threat to survival in aged populations. This report describes the survival experience of 814 aged, community dwelling hip fracture patients treated in seven Baltimore hospitals between 1984 and 1986: 4.3 per cent died during hospitalization; 8.2, 12.6, and 17.4 per cent died within three, six, and 12 months after fracture, respectively. The mortality rate for the entire population approaches expected mortality approximately six months post-fracture, but varies by age and sex. The most important factors predicting mortality are presence of serious concomitant illness and marked delirium (in the absence of dementia) at the time of hospital admission. The authors suggest that medical factors that may contribute to patient disorientation be investigated and treated, when possible, in an effort to improve the survival status of hip fracture patients. (*Am J Public Health* 1989; 79:274–278.)

Introduction

This report describes the survival experience of a recent series of hip fracture patients who entered one of seven Baltimore area hospitals between October 1, 1984 and April 30, 1986. While the survival experience of numerous series of hip fracture patients has been previously reported, the majority of these include patients treated in the late 1950s to mid-1970s,[1–25] generally before the initiation of prophylactic anticoagulant and antibiotic treatment for surgical patients.[13] Secondly, most recent hip fracture series involve patients treated outside the United States,[26–34] where treatment principles and use of technology differ markedly from those in this country.[35] Moreover, most previous reports do not differentiate the mortality experience of individuals residing in nursing homes or other long-term care institutions at the time of fracture from that of community dwelling patients,[1,3,5–11,13,15–17,19,20,22,24,25,31] and numerous studies[1,2,5,6,8,9,11,13,17,19–23,31,32,36,37] include hip fracture cases younger than age 55 for whom the cause of fracture is often severe trauma and for whom the prognosis of recovery is generally excellent.[3,24,25,37]

The present study provides more current information on the survival experience of aged hip fracture patients treated in the United States, and residing in the community at the time of their fracture, and determines at three, six, and 12 months following hip fracture the relative risk of mortality associated with selected demographic and medical indicators.

Methods

Subjects and Data Collection

Subjects consist of all patients aged 65 years or older, admitted to one of seven Baltimore area hospitals from the community with an acute fracture of the hip between October 1, 1984 and April 30, 1986. We identified the majority of patients (n = 698) through weekly calls to an established contact within each hospital, usually an orthopedic ward nurse or an admissions officer. To ensure complete enumeration of eligible cases, we reviewed hospital discharge records for cases discharged with an ICD-9 code of 820 not previously identified. An additional 116 cases were located in this manner. Data on all patients (n = 814) were obtained from hospital charts by trained interviewers using a standard protocol.

The seven study hospitals were selected on the basis of the volume of patients treated using data from the Maryland Health Services Cost Review Commission. These hospitals treat approximately half of all hip fracture patients age 65 and older treated within the 27 hospitals in the Baltimore SMSA. Study hospitals comprise a broad range of practice settings, including urban, suburban, sectarian, and public hospitals. Three of the seven hospitals have orthopedic residency programs. Elderly hip fracture patients treated in the study hospitals compared with those seen in all Baltimore area hospitals are more likely to be older than 75 years (79 per cent versus 75 per cent), female (83 per cent versus 79 per cent) and discharged to nursing homes (39 per cent versus 34 per cent).

Measures

Predictors—The demographic factors examined in this study include: age, sex, and race. The medical predictors include: type of fracture (intracapsular or extracapsular), orientation on admission, and concomitant medical conditions. The measure of orientation on admission derives from physician chart notes regarding patient status on admission. If disorientation was noted, the patient was labeled confused; if unnoted, the patient was considered mentally clear.

To account for patients' medical status pre-fracture, we constructed a binary measure of general medical condition based on whether any of the following conditions were noted in the patient's chart: cancer; stroke and related conditions; heart, atherosclerotic, liver, bladder, pulmonary, or renal disease; chronic obstructive pulmonary disease (COPD); or Parkinson's disease. These conditions were selected on the basis of previous findings involving single disease entities and mortality following hip fracture[1,9,16] and on clinician judgment. We constructed a binary measure of cognitive status based on whether or not senile dementia, Alzheimer's disease, or organic brain syndrome were noted in the hospital chart. Using this measure and an additional item concerning orientation on admission, we developed a three-category variable. The reference category includes patients with neither dementia nor noted delirium on admission; the second, consists of only patients with dementia; the third, includes cases with noted disorientation on admission, but who were not diagnosed as suffering from an organic brain syndrome. We chose to distinguish between chronic confusion due to dementia and acute confusional states or delirium

From the Department of Epidemiology and Preventive Medicine, University of Maryland School of Medicine, the Division of Orthopedics, University of Maryland Hospital, Baltimore, and the Department of Psychiatry, University of Arkansas for Medical Sciences, Little Rock. Address reprint requests to Jay Magaziner, PhD, MSHyg, Department of Epidemiology and Preventive Medicine, University of Maryland, School of Medicine, 655 W. Baltimore Street, Baltimore, MD 21201. This paper, submitted to the Journal March 21, 1988, was revised and accepted for publication August 23, 1988.

Editor's Note: See also related editorial p 269 and article p 279 this issue.

as the latter often indicates the presence of a potentially serious biomedical condition or metabolic disturbance which can deleteriously affect patient outcome.[17,38]

Outcome—We obtained the survival status of patients and date of death (when applicable) through follow-up interviews of the patient or a close friend or relative of the patient at two, six, and 12 months following hospital discharge. For 119 patients for whom we could not obtain follow-up interviews and the 116 patients identified through discharge diagnoses, the investigators searched the death records maintained by the Maryland Bureau of Vital Statistics for each patient's name and date of birth. When a match was found, staff recorded the date of death. If no death record was found, the patient was presumed still living.

Using the date of death for patients who died and the date of hospital admission, we calculated the number of days each patient survived since sustaining a hip fracture. Since hospitalization generally occurs within one or two days following a hip fracture,[22] we used the date of hospital admission as a reasonable approximation of the date of fracture.

Data Analysis

We calculated the expected one-year mortality using 10-year age group-, sex-, and race-specific death rates published by the National Center for Health Statistics for the United States population in 1982.[39] We calculated the observed mortality rate for each month following fracture and compared this with the expected death rates. In plotting the expected survival curve and in calculating the expected monthly mortality, we assumed that change in mortality is directly proportional to time over the one year follow-up period.

To examine the relative predictive value of the demographic and medical factors, we first tested for the presence of an association between each variable of interest and mortality at three, six, and 12 months post-fracture, using Yates' chi square statistic for dichotomous measures and Mantel-Haenszel's test statistic for variables with three or more ordered categories. We performed logistic regression analyses with mortality as the outcome for each time period after fracture. Odds-ratios and 0.95 confidence intervals were calculated for each factor using the beta coefficients and standard errors generated by the regression procedure following the method prescribed by Schlesselman.[40]

Results

Table 1 describes the demographic and medical characteristics of 814 patients followed for one year after sustaining hip fracture. The population consisted largely of White females with an average age of 80 years. Patients were relatively unhealthy with over 70 per cent having one or more serious concomitant illnesses and 8.6 per cent suffering from organic brain dysfunction. Thirty-seven patients (4.3 per cent) died before hospital discharge—all but one within 40 days of admission.

The proportion of patients dying within three, six, and 12 months following hip fracture is 8.2, 12.6, and 17.4 per cent, respectively. Figure 1 plots the observed and expected one year survival curves for the total population and for the population subgroups. Hip fracture patients clearly experience greater mortality than persons of similar age, race, and sex. The degree of excess mortality, however, varies by sex and age. At one year the difference between the observed and expected mortality rates is greater for males than females and greater in patients younger than 75 years than older patients. The point at which the observed survival curve parallels the expected survival curve also varies by age and by sex. The death rates for female patients and patients 85 years or older approach expected rates approximately six months post-fracture. Patients between 75 and 84 years of age experience similar mortality as expected at about 10 months after sustaining hip fracture. Elevated mortality for both males and the youngest patients appears to continue beyond the first year post-fracture.

TABLE 1—Demographic and Medical Characteristics of 814 Hip Fracture Patients, Ages 65 and Older Admitted to Seven Baltimore Area Hospitals, October 1984 to April 1986

Characteristics	Per Cent (Years)
Gender	
Male	20.2
Female	79.8
Race	
White	93.5
non-White	6.5
Age	
Mean	(80.1)
65–74	24.2
75–84	45.3
85 or above	30.6
Type of Fracture	
intracapsular	45.2
extracapsular	54.8
Concomitant severe physical illness	70.6
Dementia noted in medical chart	11.8
Delirium on admission	19.3
Delirium on admission, exclusive of dementia	7.5

Table 2 presents the relative risk of mortality at three, six, and 12 months following hip fracture associated with the seven demographic and medical factors examined. The presence of at least one life-threatening condition as noted in the patient's medical chart confers the greatest risk of mortality relative to the other factors examined at three and six months following fracture. This elevated risk diminishes with increasing time since fracture from 4.6 to 2.6 times the risk experienced by patients wtih no concomitant illness. Patients with dementia do not experience an increased risk of mortality following fracture; confidence intervals of any apparent protective effect of dementia are very wide, however. Patients with noted delirium on admission who had no history of dementia have 3.1 to 3.5 times the risk of dying as cases who were not disoriented when admitted to the hospital or who had a history of cognitive impairment.

Patients older than 84 years of age have 2.6 times the risk of dying within three months of hip fracture as patients between ages 65 and 74 years, decreasing by six months after fracture. Patients between ages 75 and 84 years do not experience an increased risk of mortality relative to patients between ages 65 and 74 years. These findings, with respect to age, are particularly noteworthy given that the expected death rate for persons 85 years of age and older is nearly six times the mortality rate for persons between ages 65 and 74 years (14.6 per cent versus 2.5 per cent) and the expected death rate in persons 75 to 84 years old is more than twice that of the rate for persons between ages 65 and 74 years (5.8 per cent versus 2.5 per cent). As expected the relative risk of mortality associated with male sex increases from 1.4 to 1.9 over time.[39] The small proportion of non-White cases (6.5 per cent) makes any finding, regarding race, difficult to interpret.

The relative risk associated with each factor after adjusting for the other factors in the models does not differ greatly from the unadjusted relative risk, except for a slight reduction in magnitude evident for each factor across all time periods.*

*Data available on request to authors.

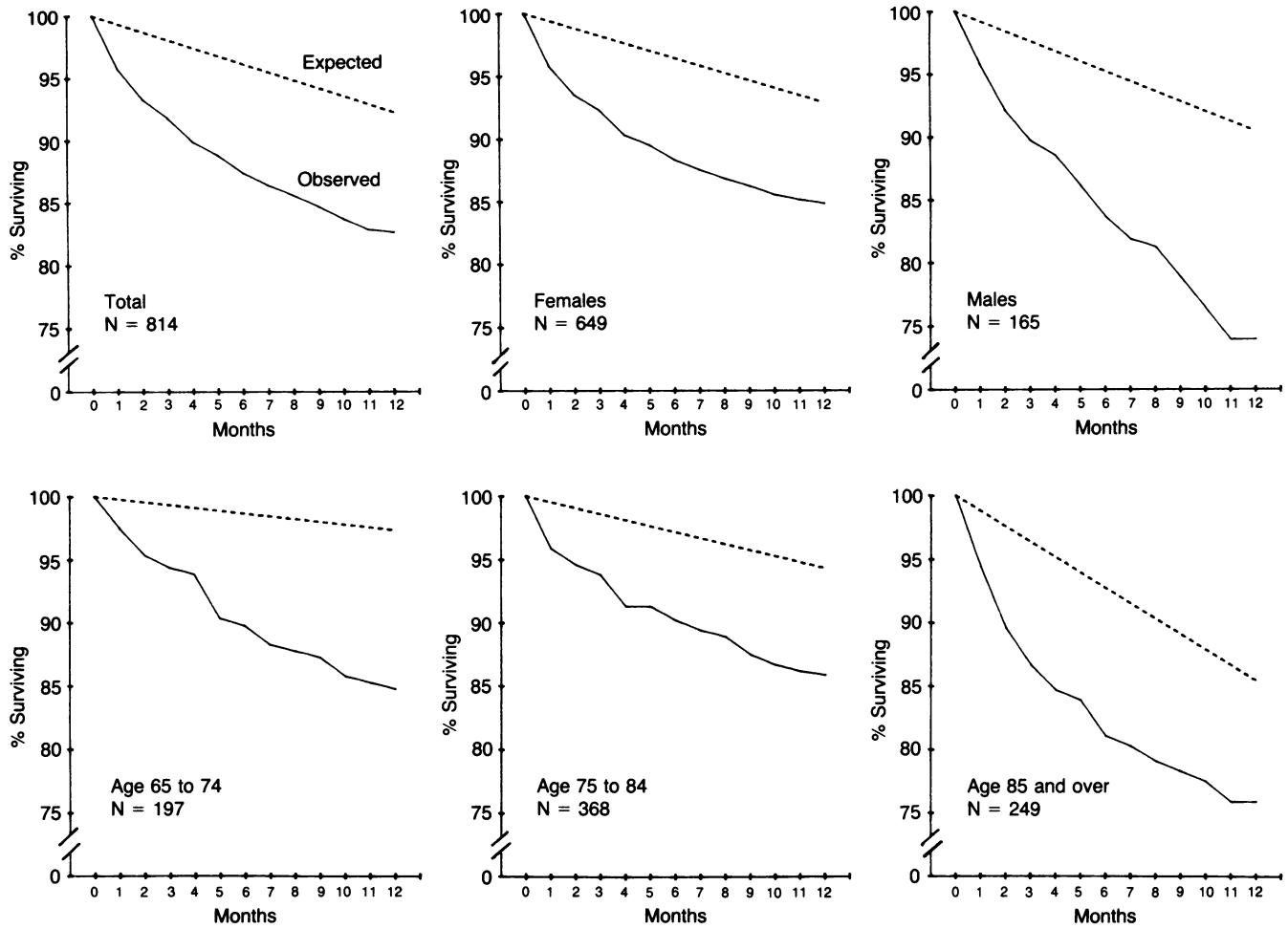

FIGURE 1—Observed and Expected Survival Curves by Sex and by Age Group for 814 Hip Fracture Patients, Ages 65 and Older, Baltimore 1984 to 1986.

Figure 2 presents the probability of one year survival given patient sex, age category, illness state, and orientation at the time of hospital admission independent of dementia. Delirium is present in a relatively small proportion of patients—7.5 per cent overall and no greater than 16.2 per cent in any subgroup. Patients older than 84 years and patients with at least one serious medical condition are more likely to become notably disoriented following their fracture than younger and healthier patients. In comparing subgroups similar in all respects except orientation on admission, we find that in all instances where valid comparisons can be made, patients with delirium on admission experience a lower probability of survival than patients with either normal orientation or a history of dementia. For female patients with no serious concomitant disease, the observed survival rate does not differ from the expected rate in either young or old patients. This relation does not hold for male hip fracture cases. Lastly, patients with serious medical problems have a lower probability of survival than patients without any serious medical conditions whether or not they become disoriented.

Discussion

Studies of mortality following hip fracture are characterized by diversity in patient populations, length of follow-up, and country of treatment. This diversity renders assessment of recent secular trends in post-fracture survival difficult, although it appears that mortality rates among hip fracture patients have generally declined between the late 1950s and the mid-1970s.[13] As such, the comparison of findings with previous work is limited to case series treated in the 1970s and later.

The in-hospital mortality rate of the current series of fracture patients is 4.3 per cent, considerably lower than the 18 and 21 per

TABLE 2—Unadjusted Relative Risk of Mortality at Three Points in Time Following Hip Fracture Associated with Selected Factors in 814 Patients Ages 65 and Older, Admitted to Seven Baltimore Area Hospitals, October 1984 to April 1986

Factors	Months Since Hip Fracture		
	Three	Six	Twelve
Sex (male)	1.4 (0.8,2.4)*	1.5 (0.9,2.4)	1.9 (1.3,2.9)
Race (non-White)	1.5 (0.6,3.6)	1.9 (0.9,3.8)	1.8 (0.9,3.3)
Extracapsular fracture	1.2 (0.7,2.0)	1.2 (0.8,1.8)	1.1 (0.7,1.6)
Ages 75 to 84**	1.1 (0.5,2.4)	1.0 (0.5,1.7)	0.9 (0.6,1.5)
Ages 85 and older**	2.6 (1.3,5.3)	2.1 (1.2,3.6)	1.8 (1.2,2.9)
Concomitant disease	4.6 (1.9,10.8)	3.6 (1.9,6.6)	2.6 (1.6,4.2)
Noted dementia	0.4 (0.1,1.7)	0.8 (0.4,1.7)	1.5 (0.9,2.5)
Delirium (exclusive of dementia)	3.2 (1.6,6.3)	3.5 (1.9,6.3)	3.1 (1.8,7.5)

*95% confidence interval in parentheses.
**relative to patients ages 65 to 74

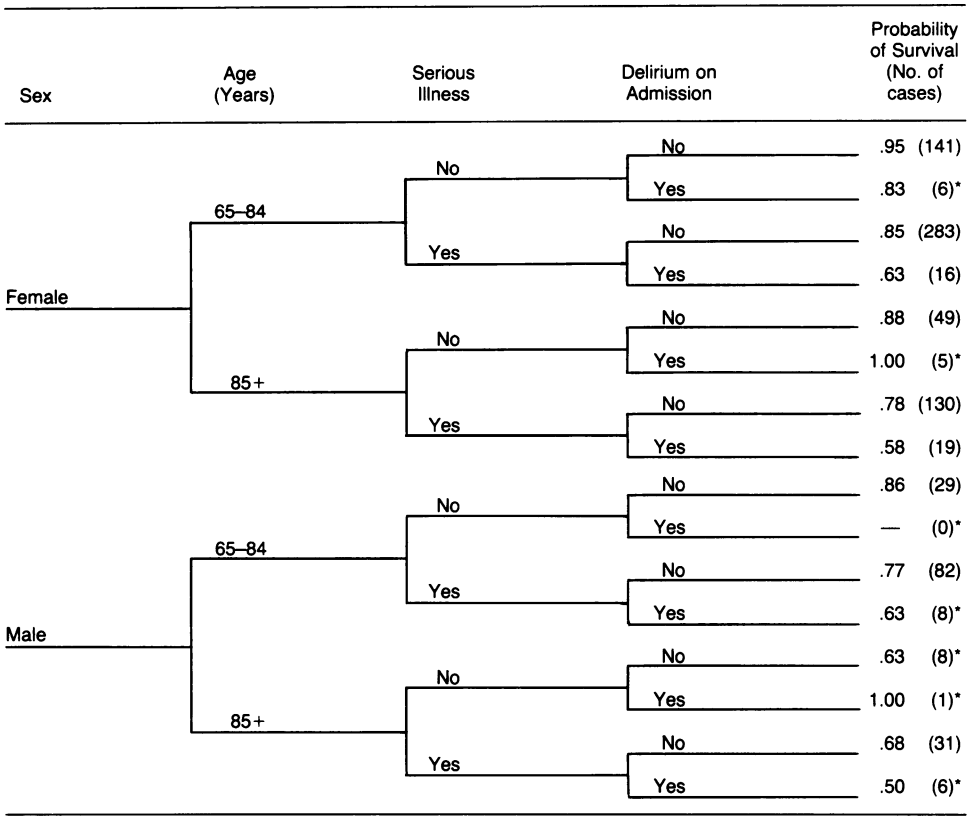

FIGURE 2—Probability of Survival One Year Following Hip Fracture Given Certain Characteristics
***Interpret probabilities with caution as these subgroups have fewer than 10 cases.**

cent mortality found for two similarly aged patient series treated, respectively, in Great Britain[26] and in Ireland[27] in 1981. The length of hospital stay for those patients averaged over 30 days, however, compared with less than 20 days for the current series. Our in-hospital mortality rate (4.3 per cent), compares favorably to the 2.0[32] and 5.8[36] found in two other recent series treated in Scandinavia that included patients as young as 50 years of age. Differences in in-hospital mortality across studies may reflect gross differences in treatment procedures, health status of patients, and/or age distribution of patients treated. While none of the case series described above include institutionalized patients, criteria for placement in and the definition of long-term care facility may vary greatly across cultures.

The one year mortality of patients in the current series (17.4 per cent) is similar to that found in two series, treated in Denmark between 1977 and 1978, that exclude non-elderly patients. One[36] had a six-month mortality of 11.1 per cent; the other,[28] 20 per cent. Differences in observed mortality reported in other studies[29,32,37] appear strongly related to the age distribution of the respective patient populations reviewed.

The observed and expected survival curves for the current series become approximately parallel six months post-fracture, but this point varies by age and sex. This finding generally agrees with earlier studies which report that a substantial portion of excess mortality occurs in the first few months following fracture.[35] Estimates from other studies of patients hospitalized since the late 1960s[5,24,28] of the point at which the mortality curve begins to parallel that for a cohort matched by age and sex range from three to 12 months.

Several investigators[1,15,19] have found a secondary rise in mortality at varying points following hip fracture ranging from four to six weeks to four to five months. Inspection of the survival curves and monthly mortality rates by age group in the current series suggests a similar phenomenon. This may reflect random variation in mortality rate rather than a true change in slope, but the possibility that a true secondary rise in mortality exists warrants exploration.

We found male sex, advanced age, presence of at least one serious illness, and delirium at the time of admission (exclusive of dementia) to represent threats to survival in the first year following hip fracture. Several previous studies report similar findings, with regard to sex, age, and concomitant disease.[1,3–5,13,24,28,33] Contrary to our finding that dementia is not associated with a higher rate of mortality, other investigations[1,24] find the presence of organic brain syndrome highly predictive of death within one year of hip fracture. These earlier reports, however, include patients from extended care facilities who may have had more advanced cases of dementia than the present community dwelling population; this difference could account for their higher death rates. While no previous reports examine the relationship between delirium at the time of hospital admission independent of dementia, the results from two prior studies are suggestive. Matheny and associates[17] found that patients who became disoriented during their hospitalization experienced much higher in-hospital mortality than patients who remained mentally clear throughout their stay (20.7 per cent versus 1.1 per cent). Barnes, *et al*,[4] examined blood urea (whose elevated levels are associated with acute confusion)[41] found the death rate among patients with elevated levels (>80 mg per 100 ml) died at five times the rate of patients with low levels (<40 mg per 100 ml).

How hip fracture contributes to delirium and why this

acute confusional state increases risk of mortality are important questions. While this area remains largely unresearched with respect to hip fracture cases, two reports offer some insight. Matheny, *et al*,[17] contend that post-fracture and post-surgical delirium may signify blood sugar or electrolyte aberrations, renal failure, infection, drug intoxication, among other clinically relevant states. Kenzora and associates[13] further suggest that patients who experience a delay in receiving medical attention may become dehydrated and that surgery before restoration of blood, fluid, and electrolyte balance may overwhelm the patient's capacity to make adequate physiologic adjustments. Taken together, these observations imply that mortality associated with patient disorientation may be amenable to treatment. Our findings tend to support this premise as marked disorientation on admission was found to make an independent contribution to patient mortality.

Several caveats are in order:

- The first concerns the dependence on medical chart notes for the measurement of dementia, confusion, and other significant medical conditions. The possible problems include: underreporting of serious medical problems, inability to evaluate the severity of various disease states, and mistaking delirium at the time of admission for dementia and visa versa.
- Second, the study population may not represent the universe of aged hip fracture patients residing in the community, as study hospitals were selected on the basis of the volume of patients treated and not for their case mix.
- Similarly, the exclusion of nursing home patients necessarily excludes patients in the poorest health. Thus, conclusions based on the current study population may not apply to all hip fracture cases.
- Fourth, the inability to determine the contribution of various disease conditions to mortality in the general population renders it impossible to distinguish the true contribution of hip fracture to patient mortality over that expected for a person with a similar health profile.
- Lastly, patient delirium noted on admission may have preceded the fracture—not followed from it.

Despite these limitations, our data indicate that excess mortality associated with hip fracture depends primarily on pre-fracture disease state and secondly on entering the hospital in an acute confusional state. Clearly, patients' pre-fracture medical status cannot be modified; however, fracture-related delirium is potentially treatable. This finding argues for careful investigation of factors that contribute to delirium as part of the standard treatment strategy.

ACKNOWLEDGMENTS

This research supported, in part, by HCFA grant 17-C-98393/3. The views expressed herein do not necessarily reflect the views of the sponsoring agency.

REFERENCES

1. Beals RK: Survival following hip fracture: Long follow-up of 607 patients. J Chronic Dis 1972; 25:235–244.
2. Katz S, Kingsbury GH, Downs TD, Ford AB, Scott CP: Long-term course of 147 patients with fracture of the hip. Surg Gynecol Obstet June 1967; 124:1219–1230.
3. Mikkelsen OA, Langholm O: Life expectancy after hip fractures in the aged. Acta Chir Scand 1964; 127:46–56.
4. Barnes R, Brown JT, Garden RS, Nicoll EA, Goda DF: Subcapital fractures of the femur. J Bone Joint Surg Feb 1976; 58-B(1):2–25.
5. Colbert DS, O'Muircheartaigh I: Mortality after hip fracture and assessment of some contributory factors. Irish J Med Sci 1976; 145:44–50.
6. Dahl E: Mortality and life expectancy after hip fractures. Acta Orthop Scand Feb 1980; 51(1):163–170.
7. Horowitz BG: Retrospective analysis of hip fractures. Surg Gynecol Obstet Sept 1966; 123:565–570.
8. Gordon PC: The probability of death following a fracture of the hip. Can Med Assoc J 1971; 105:47–62.
9. Naden D, Denbesten L: Fractures of the neck of the femur in the aged: Review of 224 consecutive cases. J Am Geriatr Soc 1969; 17(7):198–204.
10. Riska EB: Factors influencing the primary mortality in the treatment of hip fractures. Injury 1970; 2(2):107–115.
11. Smith JAR, McLauchlan J: A survey of fractures of the proximal femur. Injury 1975;6:196–210.
12. Zisserman L: Fractures in the aged, with special reference to the femur. J Am Geriatr Soc 1973; 21(5):193–199.
13. Kenzora JE, McCarthy RE, Lowell JD, Sledge CB: Hip fracture mortality: Relation to age, treatment, preoperative illness, time of surgery and complications. Clin Orthop June 1984; 186:45–55.
14. Thomas TG, Stevens RS: Social effects of fractures of the neck of the femur. Br Med J 1974; 3:456–458.
15. Evans JG: Fractured proximal femur in Newcastle upon Tyne. Age Ageing 1979; 8:16–24.
16. Evans JG, Prudham D, Wandless I. A prospective study of fractured proximal femur: Factors predisposing to survival. Age Ageing 1979; 8:246–250.
17. Matheny L II, Scott TF, Craythorne CM, Lowe RW, Mullen JO: Hospital mortality in 342 hip fractures. W Va Med J Aug 1980; 76(8):188–190.
18. Jensen JS: Trochanteric fractures: An epidemiological, clinical and biomechanical study. Acta Orthop Scand 1981; 188:9–19.
19. Jensen JS, Tondevold E: Mortality after hip fractures. Acta Orthop Scand 1979; 50:161–167.
20. Malkin S, Frankenburg F: Fractures of the hip: A three-year survey in one hospital, including experience with the Pugh Nail procedure. J Am Geriatr Soc 1978; 26:506–509.
21. Karumo I: Recovery and rehabilitation of elderly subjects with femoral neck fractures. Ann Chir Gynaecol 1977; 66:170–176.
22. McCown PL, Miller WA: Long-term follow-up of hip fractures. South Med J 1976; 69:1540–1542.
23. Ceder L, Ekelund L, Inerot S, Lindberg L, Odberg E, Sjolin C: Rehabilitation after hip fracture in the elderly. Acta Orthop Scan 1979; 50: 681–688.
24. Miller CW: Survival and ambulation following hip fracture. J Bone Joint Surg 1978; 60-a:930–933.
25. Baker BR, Duckworth T, Wilkes E: Mental state and other prognostic factors in femoral fractures of the elderly. J R Coll Gen Pract Sept 1978; 28:557–559.
26. Young TB, Gibbs ACC: Prognostic factors for the elderly with proximal femoral fracture. Arch Emerg Med Dec 1984; 1(4):215–224.
27. Beringer TRO, McSherry DMG, Taggart HMcA: A microcomputer based audit of fracture of the proximal femur in the elderly. Age Ageing 1984; 13: 344–348.
28. Kreutzfeldt J, Haim M, Bach E: Hip fracture among the elderly in a mixed urban and rural population. Age Ageing Mar 1984; 13:111–119.
29. Lund B, Hogh J, Lucht U: Trochanteric and subtrochanteric fractures. One year follow-up of a prospective study of Ender and McLaughlin osteosynthesis. Acta Orthop Scand Dec 1981; 52:645–648.
30. Lawton JO, Baker MR, Dickson RA. Femoral neck fractures—two populations. Lancet 1983; 2:70–72.
31. El Banna S, Raynal L, Gerebtzof A: Fractures of the hip in the elderly: Therapeutic and medico-social considerations. Arch Gerontol Geriatr Dec 1984; 3:311–319.
32. Ceder L, Thorngren KG, Wallden B: Prognostic indicators and early home rehabilitation in elderly patients with hip fractures. Clin Orthop Oct 1980; 152:173–184.
33. Jensen JS: Determining factors for the mortality following hip fractures. Injury May 1984; 15:411–414.
34. Holmberg S, Conradi P, Kalén R, Thorngren KG: Mortality after cervical hip fracture: 3002 patients followed for 6 years. Acta Ortho Scand 1986; 57:8–11.
35. Nickens HW: A review of factors affecting the occurrence and outcome of hip fracture, with special reference to psychosocial issues. J Am Geriatr Soc 1983; 31(3):166–170.
36. Jensen JS, Tondevold E, Sorensen PH: Social rehabilitation following hip fractures. Acta Orthop Scand Dec 1979; 50(6 pt 2):777–785.
37. Weiss NS, Liff JM, Ure CL, Ballard JH, Abbott GH, Paling JR: Mortality in women following hip fracture. J Chronic Dis 1983; 36:879–882.
38. American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, 3rd Ed. Washington, DC: American Psychiatric Association, 1980.
39. US Bureau of the Census: Statistical Abstracts of the United States: 1987, 107th Ed. Washington, DC: The Bureau, 1986.
40. Schlesselman JJ: Case-Control Studies: Design, Conduct, Analysis. New York: Oxford University Press, 1982.
41. Wolanin MO: Physiologic aspects of confusion. J Gerontol Nurs 1981; 7(4):236–242.